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CONCEALING-COLORATION: A DEMAND FOR INVESTIGATION OF MY TESTS OF THE EFFACIVE POWER OF PATTERNS.

BY ABBOTT H. THAYER.

IN 1896 naturalists received from me ('The Auk,' April, 1896) the first analysis of the effacing-power of counter-shading, and in the same article the discovery of the concealing-power of patterns (then accredited by me, through misinformation, to H. W. Bates as a previous discoverer). Soon after, I secured acceptance for the counter-shading part by proving that it was possible so to counter-shade an object as to make it invisible. *The same inevitable recognition awaits the similar effacing-power of pattern, whenever naturalists will come and study my proofs.* I, to whom they already acknowledge their debt for the discovery of counter-shading, demand to be trusted that it is I alone who am in a position to judge whether they need to study these proofs.

It begins to seem necessary to try once more to convince those naturalists who oppose me that they are acting on a misunderstanding, reiterating statements that I have never contradicted, and refusing either to notice what I do state, or to study optics itself, which is purely and simply the thing I am communicating to them.

Up to the present moment there is not a naturalist in the world who has seen any representative number of my tests of animals' costumes' background-reproduction, or who has any adequate conception what they really are. A few naturalists have seen a very few of them; and in the main those who have seen the most are the most convinced, while those who have seen none are the ones who are most loudly ridiculing the whole thing. It is among these latter that there exists an idea that the remarkable disappearance of each brilliant costume against a *certain* background merely proves my ingenuity.

When, for instance, I take a bird and spend an hour in finding a type of vegetation, situation and view-point in which he is absolutely indistinguishable, this operation is open to two inter-

pretations. To the superficial and unreceptive observer it represents merely my ingenuity. To the eye of science it is the ascertaining whether the background against which the bird can disappear is typically such a one as that against which he would commonly be looked at by his enemy or prey.¹ Invariably, it is the establishment by this means of the fact that his costume is a case of concealing-coloration. For it is evident that to match any one type of background,—sky, vegetation, or earth,—is all that any costume could do. When all these costumes prove to match the very backgrounds we think they most need to, the grounds for imputing to them other reasons for their present extremely complicated and exact development seem to lag superfluous.

For instance, the vast class of black-and-gold species, so long called conspicuous (birds, insects and reptiles), are essentially confined to regions of vegetation,—that is, where sunlight and shadow convert the whole scene itself into black and gold. Black and gold is more than nine tenths of the aspect of the deepest parts of such forest foliage as the sun can penetrate. This fact, apparently so unfamiliar to naturalists, is proved by the former fact, that amidst such a scene the black-and-gold species so closely match as to be apt to pass unnoticed if they keep still;—and a similar correspondence holds clear through the entire animal kingdom.

Many naturalists have an absurd idea that I am telling them they cannot see these species where they are conspicuous. I am merely showing them that nature could do no more than she has done to hide these species, condemned as they are by aërial habits to many moments of contrasting background, which inevitably reveal their motion. Further, that the home of the black-and-gold class is where the typical background is black and gold;—and that this principle applies to all classes the world over. An unthinking person must go on talking about the many creatures that he *sees*, and never reflect on the evidence that he *misses* many

¹ It is even the *only* means of forcing the less imaginative observer to perceive that he would always fail to detect any motionless *live* animal that happened to be as favorably backgrounded, and hence to perceive that there is a *percentage* of them that he does not discover.

others. If any doubter would, for instance, place an artificial bird the size of a peacock up in the sunlit trees, and try to color it so that it would show less in the first twenty different situations he tried for it, than a real stuffed (or live) peacock proved to show, he would begin to learn something that he has never yet dreamed of.

Hummingbirds are a beautiful demonstration of the fact that even *almost constant conspicuousness* is no evidence that the costume of a species is not oblitative. On the contrary, it will soon be recognized that the very climaxes of oblitative coloration are to be found, just where one would expect, among the very species whose activities condemn them to the greatest conspicuousness. A feeding hummer's incessant motion makes him practically one of the most conspicuous of birds; and yet, behold, when you place a *still* one anywhere amidst the same flowers, you discover that he is as exquisitely effaced by background reproduction as any barkmoth or wood frog. The very same thing is true of the flamingo, the zebra, the peacock, and, of course, the world of species of which these happen to seem to us to be climaxes.

Now, as soon as the objecting naturalists understand that by *concealing-coloration* our book means coloration that works where it is most needed, and not necessarily elsewhere, and when their attention has been called to the fact that the more the butterfly or hummer matches the flower-masses where he has to risk his life the more he must show elsewhere, they will have begun to study. On the sea, when Dr. Townsend detected all the white-backed male eiders, and not the brown females, the flock was in dark water, probably between him and the cliff. At sea, there is almost all the time a dark direction and a light one, according to the sky,—silvery water to port and dark to starboard. In the one the white eiders vanish, in the other, if it be excessively dark, the brown ones are the dimmest, but, to equal the perfect vanishing of the males when they are in bright water, the females need to be seen in actual cliff-reflection. Once out beyond these reflections, the brown eiders on a calm sea are dark spots from almost every view-point, while the white parts of the males totally disappear whenever they are looked at toward the light. I too have seen eiders, both American and European, the latter by hundreds; but this was not necessary: any white birds on the sea will do, and the case of old and young gulls is just as good to study.

The oft-repeated objection that the wearers of these costumes perpetually reveal themselves by motion, and that consequently my tests give a wrong impression, is just what shows lack of taking in what my investigation is. My whole assertion is that the *costumes* of these creatures are not what reveal them, and the objector's repeated declaration that the real animal moves and shows himself simply backs me up. The use of motionless stuffed skins is the pure method of studying the effect of the patterns *apart* from that of motion.

In behalf of those who would like to trust our book, there are a few things that it is best to say about the recent attack on it by Dr. Thomas Barbour and Mr. J. C. Phillips. These men have committed toward us many offenses. They have tried to write down a book which they prove that they have never read with any thoroughness. One example must here suffice. They write that in their judgment a flamingo would look *dark* against a dawn or evening sky,—saying this with the evident aim of implying that we state the contrary. In our text twice, and *five times* in the legends over the pictures, we clearly go over this point. Seven times in all. Their article contains four or five other serious misrepresentations of our book, aside from several misstatements about my private history.

As to Mr. H. C. Tracy's studious and most courteous article on white top marks as directive in flight, it is as obvious to me as to him that whatever constant pattern a creature wears is sure to aid in its *recognition*, both at rest and in flight. Also, that *if* he were right that white patterns displayed in flight tend to make the wearer's *course* more conspicuous to its companions, these patterns might be assumed to owe their existence in corresponding degree to this use. The trouble is, however, that it seems plain that such is not the case. Flight implies being more or less higher than the ground. In the open, the *first* bird to take flight is seen by his companions against sky, or at the angle where sky is to be *expected*, and from this view his whites tend to efface him. Then, when many birds are on wing together in the open, they are on an average moving on a level, *i. e.*, on a tangent to the earth's surface,¹

¹ More accurately, a tangent of a sphere *larger* than the world, and, of course, outside of it.

and their *average* background to each other's eyes is the bottom of the *sky*, not the earth. In the woods the case is still stronger, There even the best-illuminated white is so deeply (green-) shadowed as to average dark green-gray against the actual sky-glimpses above. Its being actually the lightest note in the place simply makes it show least, while *black* here shows most,— *i. e.*, in every upward direction; which means in half of all directions. In addition to all this, even the brightest white relieves *dark* against the brighter parts of the forest floor whenever it is itself in deeper foliage-shadow than this background. (For a fuller analysis of all this see my 'Arraignment' article¹ in the 'Popular Science Monthly' for Dec., 1909.) In other words, white in the woods is the least conspicuous of colors, and black the most so, in as many as three-quarters of all directions. Add to this that in patterns it always helps to 'cut up' the wearer; and remember also the wonderful function shown in Figs. 1, 2, 3 and 4 of the above-named 'Popular Science' article. When a white-wing-patterned bird flashes out his flight-whites, all the concealing-faculties of brilliantly contrasted patterns shown in those illustrations spring into play, *and trebly so because of motion*, when every dark part is as it were chalked over into dimness by each flap of the white-patterned wings. The inevitability of *detection* through motion had made people suppose it was the *patterns* that caused the detection. What they *do* cause is *identification after detection*.

Monadnock, New Hampshire,
September 1, 1911.

¹ I shall be delighted to send reprints of this article to all applicants.